



Eco-efficiency assessment of dairy wastewater reuse

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Title

Eco-efficiency assessment of dairy wastewater reuse

The food processing industry is a major water user in many countries and, for example, in Denmark the food sector's water use amounts to 43% of the total industrial water use. The large water consumption is related to an equally important wastewater production. Besides being costly, both water supply and wastewater management can limit the production capacity of an industrial facility, when local water resources are under stress or wastewater treatment capacity is limited. In such situations, the industry will seek to increase its water efficiency through implementation of new technology. To evaluate the eco-efficiency of new technologies we have developed a method that aligns assessment of environmental impacts and value creation within a life-cycle boundary of a food processing industry. Using standard life-cycle assessment and the concept of value added we have demonstrated the method for a proposed decentralized wastewater reuse scheme in a dairy. The life-cycle assessment covered "gate-to-retail" under the assumption that wastewater reuse at the dairy would not affect primary production and consumers' behavior. We included upstream processes like power generation and water production, and downstream processes like centralized wastewater handling and biogas production. Life-cycle assessment followed ILCD guidelines and value added was calculated for all processes likely to change more than 1% by the proposed scheme. The reuse scheme would potentially lead to an 86% reduction in drinking water imports compared to business-as-usual. The decentralized reuse facility was found to slightly increase global warming potential by 0.4 mPE/ton raw milk due to intensified water treatment. On the other hand, large reductions (-1.2 to -19 mPE/ton) were seen for impacts on the freshwater resource and nutrient enrichment. For the dairy facility, the reuse scheme would improve the value added by 1.5€/ton. However, reduced demand for water imports and less wastewater discharges to public utilities will lead to decreased value creation in these parts of the value chain. For the entire system we found a 1€/ton reduction in value added. Further studies will investigate the value added from increased production capacity and potential investment savings at the public utilities. For the specific case study, a wastewater reuse scheme was found to reduce environmental impacts from dairy production, but it comes at the cost of decreased value creation when considering the entire value chain. The applied eco-efficiency method showed the benefits and drawbacks of implementing a new technology for all involved stakeholders and the concept of value added resonates well with the commercial actors involved. The method was a good platform for comparing environmental and economic consequences and ensured consistent boundaries between the two assessments, but also stressed the importance of well-defined system boundaries.